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P.G. Saffman
Professor of Applied Mathematics

CALIFORNIA INSTITUTE OF TECHNOLOGY

APPLIED MATHEMATICS 217-50
FIRESTONE LABORATORY
PASADENA, CALIFORNIA 91125

pgs@ama-1.caltech.edu
FAX (818) 449-2677

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Dr Edwin P. Rood
Office of Naval Research
Code 1132F
800 N. Quincy Street
Arlington, VA 22217-5000

Dear Dr Rood

Research in Nonlinear Water Waves
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Work has continued during the quarter on the dynamical effects of a thin shear layer on the structure and stability of finite amplitude water waves. One problem of interest is the possibility of an 'explosive instability' discussed extensively in the Russian literature, which occurs when there is resonance between waves of opposite 'signature'. The signature can be thought of as the energy of the wave, and the explosive instability is an interaction between waves with positive and negative energy. (The concept is familiar in Plasma Physics.) The signature is easy to calculate when the undisturbed profile is of the 'stick' type, and this is the case for the Russian studies, but is not yet unambigously defined when the profiles are smooth. We are studying this problem with the help of Dr R. MacKay from the University of Warwick, who is an expert on dynamical system theory, and hope to clarify the problem and be able to extend the Russian results to smooth profiles which may be more realistic.

We have also started work on the effect of a thin, vorticity containing shear layer in the water on the Kelvin-Helmholtz and Miles instabilities of the air flow over water. We are in the process of formulating the equations and are now considering efficient methods of solution and deciding upon the relevant parts of parameter space to search. Preliminary calculations with a 'stick' profile suggest that some rather interesting results may be obtained. In order to determine the effect of a thin vortical layer, it is necessary to study first the classical case of wind over water in the absence of vorticity in the water. Our approach differs from the classical Miles-Lighthill method based on asymptotic analysis of the critical layer. We solve the Rayleigh equation numerically, and we are finding growth rates that are five times greater than those obtained by Miles. In view of the continuing interest and belief in Miles's calculations, we are endeavoring to check this result as carefully as possible and compare also with numerical solutions of the Orr-Sommerfeld equation carried out by Valenzuela and others.

Yours sincerely

P.G. Saffman

cc: ONR Pasadena
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cc: Defense Technical Information Center